WHAT IS CLAIMED IS:

1. A method for determining overlay between a plurality of first structures in a first layer of a sample and a plurality of second structures in a second layer of the sample, the method comprising:

providing targets A, B, C and D that each include a portion of the first and second structures,

wherein the target A is designed to have an offset Xa between its first and second structures portions,

wherein the target B is designed to have an offset Xb between its first and second structures portions,

wherein the target C is designed to have an offset Xc between its first and second structures portions,

wherein the target D is designed to have an offset Xd between its first and second structures portions,

wherein each of the offsets Xa, Xb, Xc and Xd is different from zero, Xa is an opposite sign and differ from Xb, and Xc is an opposite sign and differs from Xd;

illuminating the targets A, B, C and D with electromagnetic radiation to obtain spectra S_A, S_B, S_C, and S_D from targets A, B, C, and D, respectively; and

determining any overlay error between the first structures and the second structures using a linear approximation based on the obtained spectra S_A, S_B, S_C, and S_D.

2. The method of claim 1, wherein determining any overlay error comprises:

determining a difference spectrum D1 from the spectra S_A and S_B;

determining a difference spectrum D2 from the spectra S_C and S_D;

determining any overlay error by performing a linear approximation based on the difference spectra D1 and D2.

3. The method as recited in claim 2, wherein the linear approximation is based on a property P1 of the difference spectrum D1 and a property P2 of the difference spectrum D2.

4. The method of claim 1, wherein each of the targets A, B, C, and D comprises a grating structure Ga1 having periodic structures with a period Ta1 disposed at least partially within the first layer and a grating structure Ga2 having periodic structures with a period Ta2 disposed at least partially within the second layer, wherein the first period Ta1 and the second period Ta2 are substantially identical, and wherein the offsets Xa, Xb, Xc, and Xd are each produced by offsetting the structures with the period Ta1 of the grating structure Ga1 with respect to the structures with the period Ta2 of the grating structure Ga2 by the sum of a first distance F and a second distance f0, wherein the second distance f0 has a smaller absolute value than the first distance F.

5. The method of claim 1, wherein the targets A, B, C and D are disposed along a substantially straight line.

6. The method of claim 5, wherein the target B is disposed between the target A and the target C, and the target C is disposed between the target B and the target D.

7. The method of claim 1, wherein the targets A, B, C and D are disposed in a two dimensional configuration.

8. The method of claim 7, wherein the targets A and B are disposed along a first axis, the targets C and D are disposed along a second axis, and the first axis and the second axis are substantially parallel.

9. The method of claim 1, the method further comprising:

producing an additional target E, the additional target E including a portion of the first and second structures with an offset Y there between;

illuminating the additional target E with electromagnetic radiation to obtain spectra S_E; and

wherein the determining any overlay error is further based on the spectrum S_E.

10. The method of claim 1, wherein obtaining the spectra S_A, S_B, S_C, and S_D comprises acquiring radiation from the targets A, B, C, and D using an optical apparatus.

11. The method of claim 10, wherein the optical apparatus is an imaging reflectometer.

12. The method of claim 10, wherein the optical apparatus is an imaging spectroscopic reflectometer.

13. The method of claim 10, wherein the optical apparatus is a polarized spectroscopic imaging reflectometer.

14. The method of claim 10, wherein the optical apparatus is a scanning reflectometer system.

15. The method of claim 10, wherein the optical apparatus is a system with two or more reflectometers capable of parallel data acquisition.

16. The method of claim 10, wherein the optical apparatus is a system with two or more spectroscopic reflectometers capable of parallel data acquisition.

17. The method of claim 10, wherein the optical apparatus is a system with two or more polarized spectroscopic reflectometers capable of parallel data acquisition.

18. The method of claim 10, wherein the optical apparatus is a system with two or more polarized spectroscopic reflectometers capable of serial data acquisition without moving the wafer stage or moving any optical elements or the reflectometer stage.

19. The method of claim 10, wherein the optical apparatus is an imaging spectrometer.

20. The method of claim 10, wherein the optical apparatus is an imaging system with a wavelength filter.

21. The method of claim 20, wherein the optical apparatus is an imaging system with a long-pass wavelength filter.

22. The method of claim 20, wherein the optical apparatus is an imaging system with a short-pass wavelength filter.

23. The method of claim 10, wherein the optical apparatus is an interferometric imaging system.

24. The method of claim 10, wherein the optical apparatus is an imaging ellipsometer.

25. The method of claim 10, wherein the optical apparatus is an imaging spectroscopic ellipsometer.

26. The method of claim 10, wherein the optical apparatus is a scanning ellipsometer system.

27. The method of claim 10, wherein the optical apparatus is a system with a plurality of ellipsometers capable of parallel data acquisition.

28. The method of claim 10, wherein the optical apparatus is a system with a plurality of ellipsometers capable of serial data acquisition without moving the wafer stage or moving any optical elements or the ellipsometer stage.

29. The method of claim 10, wherein the optical apparatus is a Michelson interferometer.

30. The method of claim 10, wherein the optical apparatus is a Mach-Zehnder interferometer.

31. The method of claim 10, wherein the optical apparatus is or a Sagnac interferometer.

32. The method of claim 10, wherein the optical apparatus is a system comprising a spectroscopic normal incidence reflectometer and an oblique incidence spectroscopic ellipsometer.

33. The method of claim 10, wherein the optical apparatus is a system comprising a spectroscopic normal incidence polarized reflectometer and an oblique incidence spectroscopic ellipsometer.

34. The method of claim 10, wherein the optical apparatus is a system comprising a spectroscopic normal incidence polarized differential reflectometer and an oblique incidence spectroscopic ellipsometer.

35. The method of claim 10, wherein the optical apparatus is a system comprising a spectroscopic near-normal incidence polarized differential reflectometer and an oblique incidence spectroscopic ellipsometer.

36. The method of claim 10, wherein the optical apparatus is a system comprising a spectroscopic normal incidence reflectometer and a spectroscopic oblique incidence polarized differential reflectometer.

37. The method of claim 10, wherein the optical apparatus is a system comprising a spectroscopic normal incidence polarized reflectometer and a spectroscopic oblique incidence polarized differential reflectometer.

38. The method of claim 10, wherein the optical apparatus is a system comprising a spectroscopic normal incidence polarized differential reflectometer and a spectroscopic oblique incidence polarized differential reflectometer.

39. The method of claim 10, wherein the optical apparatus is a system comprising a spectroscopic near-normal incidence polarized differential reflectometer and a spectroscopic oblique incidence polarized differential reflectometer.

40. The method of claim 1, wherein at least one of the spectra S_A, S_B, S_C, and S_D comprises electromagnetic radiation that is unpolarized or selectively polarized or selectively analyzed.

41. The method of claim 1, wherein at least one of the spectra S_A, S_B, S_C, and S_D comprises electromagnetic radiation that is unpolarized reflected light, polarized light with the electric field substantially parallel to a symmetry axis of at least one set of structures of at least one of the targets A, B, C or D, polarized light with the electric field substantially perpendicular to a symmetry axis of at least one set of structures of at least one of the targets A, B, C or D, polarized light with the electric field at an angle with respect to a symmetry axis of at least one set of structures of at least one of the targets A, B, C or D, right-hand circularly polarized radiation, or left-hand circularly polarized radiation.

42. The method of claim 3, wherein the properties P1 and P2 of the difference spectra D1 and D2 each are selected from a group consisting of light noise, stability, drift, spectral characteristics, and light level.

43. The method of claim 1, wherein the illuminating the targets A, B, C and D with electromagnetic radiation takes place substantially at different times such that the corresponding spectra S_A, S_B, S_C, and S_D are obtained at substantially different times.

44. The method of claim 1, wherein the illuminating the targets A, B, C and D with electromagnetic radiation takes place substantially simultaneously such that the corresponding spectra S_A, S_B, S_C, and S_D are produced substantially simultaneously.

45. The method of claim 1, wherein the illuminating the targets A, B, C and D with electromagnetic radiation takes place substantially simultaneously for at least two of the targets A, B, C and D.

46. The method of claim 3 where determining the properties P1 and P2 comprises obtaining or processing one or more of radiation characteristics of the difference spectra D1 and D2, respectively, selected from a group consisting of intensity, spectral intensity of diffracted radiation, R(lambda) of different radiation, spectral intensity of transverse electric field polarization R(Te, lambda), spectral intensity of transverse magnetic field polarization R(Tm, lambda), spectral intensity of S-polarization reflectivity Rs (lambda), spectral intensity of P-polarization, reflectivity Rp(lambda), optical phase, wavelength, diffraction angle, spectroscopic ellipsometry parameters, alpha, beta, cos(delta), and tan(psi).

47. The method of claim 19, wherein an illumination and imaging NA's of the spectroscopic imaging system are chosen to optimize the performance of the instrument on scattering structures by ensuring that only the zero'th diffraction order is collected.

48. The method of claim 47, wherein the spectroscopic imaging system is an imaging spectroscopic ellipsometer.

49. The method of claim 1, wherein obtaining the spectra S_A, S_B, S_C, and S_D comprises acquiring an image from the targets A, B, C, and D using an imaging apparatus having a wavelength filter, and wherein the spectra S_A, S_B, S_C, and S_D are an averaged or summed one or more intensity value(s) of one or more pixels of the corresponding target image, the method further comprising selecting a wavelength using the wavelength filter such that contrast between the S_A, S_B, S_C, and S_D is maximized.

50. The method of claim 49, further comprising analyzing the images of the targets to detect defects in the sample.

51. The method of claim 1, wherein obtaining the spectra S_A, S_B, S_C, and S_D comprises acquiring radiation from the targets A, B, C, and D using an optical apparatus, wherein the radiation is acquired at simultaneous, multiple angles of illumination.

52. The method of claim 19, further comprising focusing the optical tool only for illuminating a one of the targets A, B, C, and D and not refocusing the optical tool for illuminating the other three of the targets A, B, C, and D.

53. The method of claim 1, wherein at least one of the targets A, B, C, and D includes an imaging overlay metrology type target, and the method further comprises measuring a second overlay error on the imaging overlay metrology type target.

54. The method of claim 53, wherein the obtained spectra S_A, S_B, S_C, and S_D are images and are also used to perform the overlay error measurement of the imaging overlay metrology type target.

56. The method of claim 53, wherein the first overlay is determined simultaneously with measurement of the second overlay error.

57. A system for determining overlay between a plurality of first structures in a first layer of a sample and a plurality of second structures in a second layer of the sample, comprising:

a scatterometry module for illuminating the targets A, B, C and D with electromagnetic radiation to obtain spectra S_A, S_B, S_C, and S_D from targets A, B, C, and D, respectively ; and

a processor operable for determining any overlay error between the first structures and the second structures using a linear approximation based on the obtained spectra S_A, S_B, S_C, and S_D,

wherein targets A, B, C and D each include a portion of the first and second structures,

wherein the target A is designed to have an offset Xa between its first and second structures portions,

wherein the target B is designed to have an offset Xb between its first and second structures portions,

wherein the target C is designed to have an offset Xc between its first and second structures portions,

wherein the target D is designed to have an offset Xd between its first and second structures portions, and

wherein each of the offsets Xa, Xb, Xc and Xd is different from zero, Xa is an opposite sign and differ from Xb, and Xc is an opposite sign and differs from Xd.

58. The system of claim 57, wherein determining any overlay error comprises:

determining a difference spectrum D1 from the spectra S_A and S_B;

determining a difference spectrum D2 from the spectra S_C and S_D;

determining any overlay error by performing a linear approximation based on the difference spectra D1 and D2.

59. The system as recited in claim 58, wherein the linear approximation is based on a property P1 of the difference spectrum D1 and a property P2 of the difference spectrum D2.

60. The system of claim 57, wherein the targets A, B, C and D are disposed along a substantially straight line.

61. The system of claim 60, wherein the target B is disposed between the target A and the target C, and the target C is disposed between the target B and the target D.

62. The system of claim 57, wherein the targets A, B, C and D are disposed in a two dimensional configuration.

63. The system of claim 62, wherein the targets A and B are disposed along a first axis, the targets C and D are disposed along a second axis, and the first axis and the second axis are substantially parallel.

64. The system of claim 57, wherein the processor is further operable for:

producing an additional target E, the additional target E including a portion of the first and second structures with an offset Y there between;

illuminating the additional target E with electromagnetic radiation to obtain spectra S_E; and

wherein the determining any overlay error is further based on the spectrum S_E.

65. The system of claim 57, wherein the scatterometry module is an optical apparatus.

66. The system of claim 65, wherein the optical apparatus is an imaging reflectometer.

67. The system of claim 65, wherein the optical apparatus is an imaging spectroscopic reflectometer.

68. The system of claim 65, wherein the optical apparatus is a polarized spectroscopic imaging reflectometer.

69. The system of claim 65, wherein the optical apparatus is a scanning reflectometer system.

70. The method of claim 65, wherein the optical apparatus is a system with two or more reflectometers capable of parallel data acquisition.

71. The system of claim 65, wherein the optical apparatus is a system with two or more spectroscopic reflectometers capable of parallel data acquisition.

72. The system of claim 65, wherein the optical apparatus is a system with two or more polarized spectroscopic reflectometers capable of parallel data acquisition.

73. The system of claim 65, wherein the optical apparatus is a system with two or more polarized spectroscopic reflectometers capable of serial data acquisition without moving the wafer stage or moving any optical elements or the reflectometer stage.

74. The system of claim 65, wherein the optical apparatus is an imaging spectrometer.

75. The system of claim 65, wherein the optical apparatus is an imaging system with a wavelength filter.

76. The system of claim 75, wherein the optical apparatus is an imaging system with a long-pass wavelength filter.

77. The system of claim 75, wherein the optical apparatus is an imaging system with a short-pass wavelength filter.

78. The system of claim 65, wherein the optical apparatus is an interferometric imaging system.

79. The system of claim 65, wherein the optical apparatus is an imaging ellipsometer.

80. The system of claim 65, wherein the optical apparatus is an imaging spectroscopic ellipsometer.

81. The system of claim 65, wherein the optical apparatus is a scanning ellipsometer system.

82. The system of claim 65, wherein the optical apparatus is a system with a plurality of ellipsometers capable of parallel data acquisition.

83. The system of claim 65, wherein the optical apparatus is a system with a plurality of ellipsometers capable of serial data acquisition without moving the wafer stage or moving any optical elements or the ellipsometer stage.

84. The system of claim 65, wherein the optical apparatus is a Michelson interferometer.

85. The system of claim 65, wherein the optical apparatus is a Mach-Zehnder interferometer.

86. The system of claim 65, wherein the optical apparatus is or a Sagnac interferometer.

87. The system of claim 65, wherein the optical apparatus is a system comprising a spectroscopic normal incidence reflectometer and an oblique incidence spectroscopic ellipsometer.

88. The system of claim 65, wherein the optical apparatus is a system comprising a spectroscopic normal incidence polarized reflectometer and an oblique incidence spectroscopic ellipsometer.

89. The system of claim 65, wherein the optical apparatus is a system comprising a spectroscopic normal incidence polarized differential reflectometer and an oblique incidence spectroscopic ellipsometer.

90. The system of claim 65, wherein the optical apparatus is a system comprising a spectroscopic near-normal incidence polarized differential reflectometer and an oblique incidence spectroscopic ellipsometer.

91. The system of claim 65, wherein the optical apparatus is a system comprising a spectroscopic normal incidence reflectometer and a spectroscopic oblique incidence polarized differential reflectometer.

92. The system of claim 65, wherein the optical apparatus is a system comprising a spectroscopic normal incidence polarized reflectometer and a spectroscopic oblique incidence polarized differential reflectometer.

93. The system of claim 65, wherein the optical apparatus is a system comprising a spectroscopic normal incidence polarized differential reflectometer and a spectroscopic oblique incidence polarized differential reflectometer.

94. The system of claim 65, wherein the optical apparatus is a system comprising a spectroscopic near-normal incidence polarized differential reflectometer and a spectroscopic oblique incidence polarized differential reflectometer.

95. The system of claim 57, wherein at least one of the spectra S_A, S_B, S_C, and S_D comprises electromagnetic radiation that is unpolarized or selectively polarized or selectively analyzed.

96. The system of claim 57, wherein at least one of the spectra S_A, S_B, S_C, and S_D comprises electromagnetic radiation that is unpolarized reflected light, polarized light with the electric field substantially parallel to a symmetry axis of at least one set of structures of at least one of the targets A, B, C or D, polarized light with the electric field substantially perpendicular to a symmetry axis of at least one set of structures of at least one of the targets A, B, C or D, polarized light with the electric field at an angle with respect to a symmetry axis of at least one set of structures of at least one of the targets A, B, C or D, right-hand circularly polarized radiation, or left-hand circularly polarized radiation.

97. The system of claim 59, wherein the properties P1 and P2 of the difference spectra D1 and D2 each are selected from a group consisting of light noise, stability, drift, spectral characteristics, and light level.

98. The system of claim 57, wherein the illuminating the targets A, B, C and D with electromagnetic radiation takes place substantially at different times such that the corresponding spectra S_A, S_B, S_C, and S_D are obtained at substantially different times.

99. The system of claim 57, wherein the illuminating the targets A, B, C and D with electromagnetic radiation takes place substantially simultaneously such that the corresponding spectra S_A, S_B, S_C, and S_D are produced substantially simultaneously.

100. The system of claim 57, wherein the illuminating the targets A, B, C and D with electromagnetic radiation takes place substantially simultaneously for at least two of the targets A, B, C and D.

101. The system of claim 59, where determining the properties P1 and P2 comprises obtaining or processing one or more of radiation characteristics of the difference spectra D1 and D2, respectively, selected from a group consisting of intensity, spectral intensity of diffracted radiation, R(lambda) of different radiation, spectral intensity of transverse electric field polarization R(Te, lambda), spectral intensity of transverse magnetic field polarization R(Tm, lambda), spectral intensity of S-polarization reflectivity Rs (lambda), spectral intensity of P-polarization, reflectivity Rp(lambda), optical phase, wavelength, diffraction angle, spectroscopic ellipsometry parameters, alpha, beta, cos(delta), and tan(psi).

102. The system of claim 74, wherein an illumination and imaging NA's of the spectroscopic imaging system are chosen to optimize the performance of the instrument on scattering structures by ensuring that only the zero'th diffraction order is collected.

103. The system of claim 102, wherein the spectroscopic imaging system is an imaging spectroscopic ellipsometer.

104. The system of claim 57, wherein obtaining the spectra S_A, S_B, S_C, and S_D comprises acquiring an image from the targets A, B, C, and D using an imaging apparatus having a wavelength filter, and wherein the spectra S_A, S_B, S_C, and S_D are an averaged or summed one or more intensity value(s) of one or more pixels of the corresponding target image, the method further comprising selecting a wavelength using the wavelength filter such that contrast between the S_A, S_B, S_C, and S_D is maximized.

105. The system of claim 104, wherein the processor is further operable for analyzing the images of the targets to detect defects in the sample.

106. The system of claim 57, wherein the scatterometry module is an optical apparatus, wherein the radiation is acquired at simultaneous, multiple angles of illumination.

107. The system of claim 74, wherein the processor is further operable for focusing the optical tool only for illuminating a one of the targets A, B, C, and D and not refocusing the optical tool for illuminating the other three of the targets A, B, C, and D.

108. The system of claim 57, wherein at least one of the targets A, B, C, and D includes an imaging overlay metrology type target, and the method further comprises measuring a second overlay error on the imaging overlay metrology type target.

109. The system of claim 108, wherein the obtained spectra S_A, S_B, S_C, and S_D are images and are also used to perform the overlay error measurement of the imaging overlay metrology type target.

110. The system of claim 108, wherein the first overlay is determined simultaneously with measurement of the second overlay error.

111. A target arrangement comprising a first layer having a plurality of first structures and a second layer having a plurality of second structures, the target arrangement further comprising:

targets A, B, C and D that each include a portion of the first and second structures,

wherein the target A is designed to have an offset Xa between its first and second structures portions,

wherein the target B is designed to have an offset Xb between its first and second structures portions,

wherein the target C is designed to have an offset Xc between its first and second structures portions,

wherein the target D is designed to have an offset Xd between its first and second structures portions,

wherein each of the offsets Xa, Xb, Xc and Xd is different from zero, Xa is an opposite sign and differ from Xb, and Xc is an opposite sign and differs from Xd, and

wherein the offsets Xa, Xb, Xc, and Xd are selected so that when the targets A, B, C, and D are illuminated with electromagnetic radiation, the targets A, B, C,

and D produce a corresponding spectra S_A, S_B, S_C, and S_D, respectively which are indicative of any overlay error existing between the first layer and the second layer structures; and

an imaging overlay measurement type target E from which a second overlay error may be determined using imaging overlay metrology.